International Journal of Advanced Engineering Research and Science (IJAERS)
Peer-Reviewed Journal
ISSN: 2349-6495(P) | 2456-1908(O)
Vol-9, Issue-11; Nov, 2022
Journal Home Page Available: https://ijaers.com/
Article DOI: https://dx.doi.org/10.22161/ijaers.911.35

An Analysis of Urban Noise and its Impacts - Case Study

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Received: 22 Oct 2022,

Received in revised form: 08 Nov 2022,

Accepted: 14 Nov 2022,

Available online: 21 Nov 2022

***Keywords*— Acoustic comfort, Noise measurement, Sound Pollution, Noise, Via urban.**

***Abstract*—** *Noise is generally an unwanted sound or a sound that produces unpleasant effects and causes discomfort to the ears. Sound becomes undesirable when it interferes with normal activities such as sleeping, talking, or when it interrupts or decreases quality of life. Not every noise can be called pollution, especially if it doesn't happen regularly. Urban areas generally have more unpleasant acoustic frequencies to the ears than rural areas because they are a complex mix of transport noises, factories, industries, machinery, and people. Urban noise, when excessive and continuous, impairs the quality of life in cities. The problem of excess noise has increased due to the imbalance between urban development and the increase in motorized traffic on streets and highways, and therefore the to such noise generated by urban traffic has increased significantly and has been the main responsible for violations of noise patterns and the acoustic comfort of people. This case study work sees you as the main objective to evaluate and discuss noise levels in a very moving road and the repercussions caused by noise pollution. A linear stretch of a road of large circulation of vehicles was chosen for the study, for its variety of uses, such as commercial, residential and services. This route has been the subject of numerous complaints from people who live and/or work in it. After the result of sixteen measurements, at three different times and days, eight on each side of the chosen stretch of the road, it was found that noise levels are above the limits described by the current legislation related to acoustic comfort.*

I. INTRODUCTION

Urban noise is one of the main factors that can impair the quality of life in cities. These problems have increased due to the imbalance between urban development and increased motorized traffic on streets and highways. Therefore, the total noise generated by urban traffic has increased significantly and has been the main responsible for violations of noise patterns and the acoustic comfort of people (SALIBA, 2018).

An evaluation of noise levels on urban roads allows one to observe situations that can compromise the well-being, comfort, health, productivity, income of a person, among others, seeking to eliminate, neutralize or control the deleterious effects to road users, and, above all, propose mitigating measures against the causating agents of these inconveniences, knowing that noise pollution has direct interference with urban growth and, consequently, with the greater use of vehicles in the street (MURGEL, 2007).

It can be affirmed that urban growth, concentrating along main and secondary roads in the various locations, which facilitate the locomotion and comfort of people seeking consumable goods, fun, work, services, among others, has a direct reflection on the landscape and the dissemination of the form of noise pollution, among others, significantly impacting the various users of the roads, because there is the dissemination of fixed sound sources (establishment of labor activities, machinery and equipment, etc.) and mobile, such as the passage of vehicles of various types and models with their aggregates sound pollutants (horn, tires, engine, etc.), as well as air traffic with airplanes, helicopters and other forms of noise production (LEITÃO, 2021).

The characteristics of the road assume great importance in the repercussion of noise pollution, since the flow of vehicles, the type of vehicle, maintenance, schedule, type of pavement and its conservation, if the floor is dry or wet, among other variables, have a severe impact on the high levels of noise in the road and its surroundings (MARTINS, 2014; GUEDES et al, 2014).

This case study has as main objective to evaluate and discuss noise levels in a path of great movement and the possible impacts caused to human health by noise pollution.

II. METHODOLOGY

STUDY AREA

The choice of the studied site was due to complaints from road dwellers, according to how it is commonly reported in the media, about the intense local traffic and the discomfort generated by various sources of noise, especially during peak vehicle circulation times. Firstly, a linear stretch with a length of 578.0 meters was defined (Latitude - 8.1789397 and Longitude -34.9198116; and Latitude -8.1826009 and Longitude -34.9259233), in the municipality of Jaboatão dos Guararapes, Pernambuco, Brazil (Figure 1). The choice of location is justified by the significant variety of shops, services, and residences.

Then, the points to be measured (08 points on each side of the avenue) were determined. geographical coordinates illustrated in Figure 2, considering the various forms of use of the site. In the measurements of the right side (LD) of the road, there was a more intense flow of buses, where there are several stops and predominance of trades and services, in addition to some housing units. On the left side (LE), there is a bike path throughout the stretch of the evaluated stretch, in addition to shops, services and residences. Measurements were made in front of a Commercial Gallery, small street trade, gas station, bakery, sawmill and furniture, bus stop, auto school, language school, car wash, sowing, water aerobics gym and residences. The data and map of the occupation of the territory were obtained through Google Maps (2022).

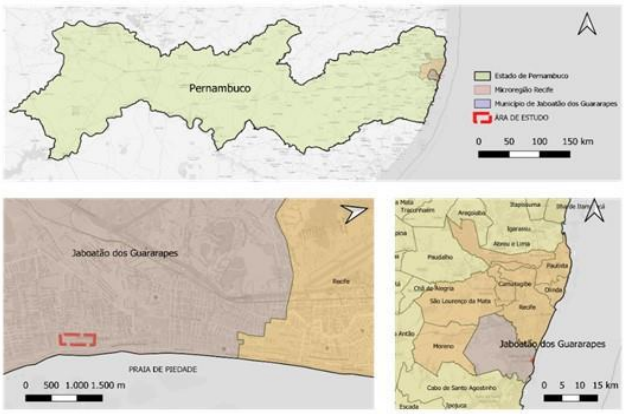

Fig.1: Location of the study area.

Fig.2: Location of the study area.

Source: Google Maps (2022).

METHODOLOGICAL STEPS

To perform the measurements of the noises was used a Digital Sonometer, marc Criffer, Model Octava Plus, serial number 35000438, with filter bands of 1/3 and 1/8; Digital noise calibrator, Criffer brand, CR-2 model, series number 36001203, both calibrated by the LABELO Laboratory of the Pontifical Catholic University of Rio Grande do Sul (PUCRS), with Calibration Certificates No. A0331 and A0299, respectively, traced by the Brazilian Certification Network (RBC) and according to the brazilian association of technical standards (ABNT) NBR ISO IEC 17025/2017, as well as the methodology adopted by Bistafa (2018).

At each point, the sonometer was positioned on the sidewalk, 0.30 m away from the wire guide, fixed on a tripod with a fixed height of 1.50m, always more than 1.00 m from any walls, in accordance with NBR 10.151/2020

and 10.152/2020, from ABNT. Each measurement lasted an average of 6 minutes and 20 seconds which is the average time to open and close the traffic lights, which have a timer of 90 seconds. The other traffic light of the cross, last about 35 to 45 seconds between opening and closing.

The measurements were performed from Sunday to Sunday, for 02 weeks, between the months of March to April 2022, in three different shifts (morning, afternoon and night), always with heavy traffic. In the morning, it was measured from 6:30 a.m. to 8:30 a.m.; in the afternoon, from 11:30 to 14:30, and in the evening from 17:30 to 20:30.

At the end of each day, the data were downloaded in a specific program of the instrument in the form of a report, to list the information received. After completion of the measurements, all reports with weighted average values (Leq), Peak Values (Max), were grouped into spreadsheets generated in the Microsoft Excel software, with frequency charts.

III. RESULTS AND DISCUSSION

SAMPLE POINTS

Observing the cutout of 578.0 meters of study area, 16 points were chosen (Figure 3), and, in these, the explicit and implicit characteristics of local nature were observed. In this road there is a large circulation of buses with constant noises of deceleration, braking and acceleration of collectives, horns, and cries of minibus operators to get the attention of possible passengers. The pathways are also characterized by holes and depressions.

Fig.3: Measuring Points.

Source: Google Maps (2022).

MEASUREMENT RESULTS

Considering the values of the noises obtained in the field, the results can be observed in Figure 4. The following data were obtained from the means observed in the measurements taken over two months.

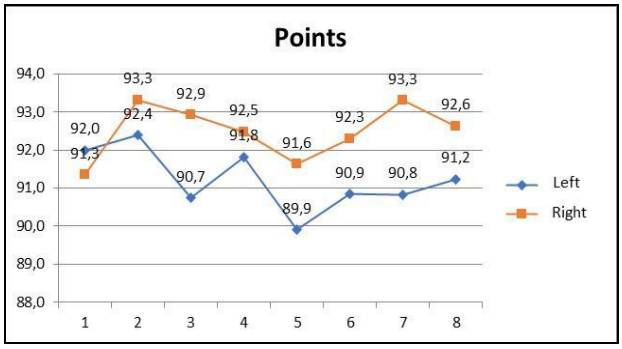

Fig.4: Average noise values per point.

Source: The Authors (2022).

All the values found in the measurements performed are above the values indicated in the technical standard of THE ABNT - NBR-10.152:2020, which establishes 60 dB(A) of limits as being value to be respected in relation to the acoustic comfort of the environments, in the day shift, and 55 dB(A) for the night shift, for mixed areas, with commercial and administrative predominance. In cases where the area is mixed, with residential predominance, this standardized value is 55 dB(A) for the day shift and 50 dB(A) for the night shift. Therefore, it can be verified that in some parts of the road there is a predominance of commercial and administrative activities, while in the other points it is also a mixed area, but with residential predominance. Figure 3 also shows all the means of the Leq (equivalent noise level) in both points, right and left side of the track, where they were sharply outdated, considering the measurements performed in the intervals mentioned, in the day shift, that is, between 6 and 20 hours.

Based on the observation of the site, the right lane has a predominance of bus and minibus traffic and that of the left of other types of vehicles. When opening the sign, at intersections, motorcycles are primarily moved, especially those with the largest number of cylinders and those used by food/goods delivery companies, who take the lead in relation to other vehicles when opening the signal. At several other times, motorized bicycles and motorcycles, including some of the high displacement, use the bike path track, which interfered in some measurements given the proximity they passed in relation to the sonometer.

Another significant data is that, along the studied stretch, there are some visits, popularly called "wolf mouths", where the lid, being metal and not perfectly adjusted in place, generates additional noise by passing cars over them. The track contains deformations or depressions on the asphalt, or even uneven manholes in

relation to the asphalt that produces a significant increase in noise, especially when passing heavy and/or large vehicles, and, in precarious conservation conditions, as was possible in some points.

The use of horns in an unnecessary and high intensity way, both motorcycle, bus, minibuses, trucks and even bicycle users who use compressed air horns to draw pedestrian attention or rush them in front of them is common, going against Art. 41 of the Brazilian Traffic Code (BRASIL, 1977).

There is also a great interference in the noise levels of motorcycles and vehicles that are powerful and/or high-displacement and/or those that use the so-called "open exhaust" infringing Art. 230, also of the Brazilian Traffic Code (BRASIL, 1977), in its item XI, which treats as a traffic violation the driver who traffics his vehicle "with free discharge or silencer of defective explosion engine, disabled or inoperative." This type of situation generates noise peaks that exceed 100 dB(A).

Average time values

Performing a time frame, it is observed, from the measurements taken that in relation to the days of the week, it is perceived that the average noise levels (Figure 5) are very close, having a peak on Tuesday and the lowest average on Sunday. The peak is due to moments of passage of vehicles, especially high-powered motorcycles and cars with open exhausts generating high sound levels that impacted the overall average of that day. On the other hand, on Sunday, there was a lower flow of vehicles, especially in the morning shift, implying the lowest average of the temporal aspect.

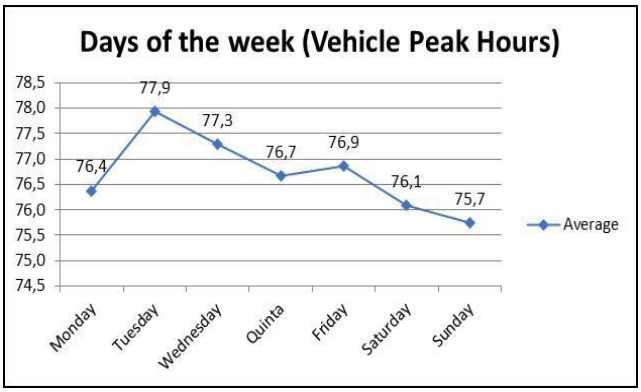

Fig.5: Average values per day of the week.

Source: The Authors (2022)

Observing the average noise per shift (Figure 6), it is observed that the morning shift (6:30 to 8:30 h) and in the afternoon (11:30 to 14:00h) maintained their identical averages, with a lowering in the average of the night period (17:30 to 20:30h). In the morning and afternoon shifts, there is a lower flow of vehicles, which makes the flow freer and, consequently, greater accelerations and decelerations, in addition to the great use of horns.

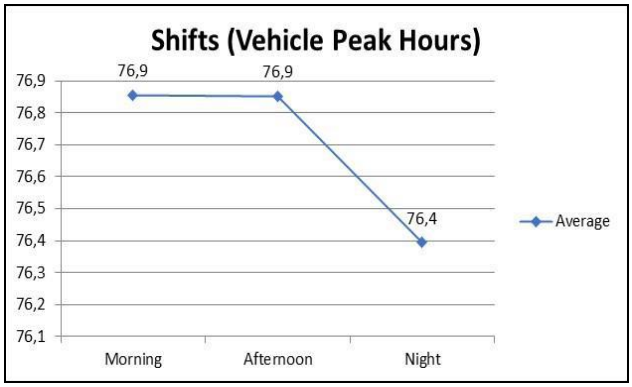

Fig.6: Average measurements per shift.

Source: The Authors (2022).

Also, it can be highlighted that in the morning, there is a more intense and slightly faster flow of the collectives, and in the afternoon, there is a greater flow of light vehicles returning from schools and jobs, and from delivery men, usually on motorcycles, due to the proximity to lunchtime. On the other hand, on the night shift, the flow of traffic is more intense, due to the return of road users to their home, which makes it slower and without intense accelerations and decelerations since the average speed is much lower than in the other shifts, because it has greater "congestion" on the road. Comparing the results obtained with the studies by Calixto, Zanin and Diniz (2002) where they found that the highways entering the urban perimeter of Curitiba, the average value of traffic noise emissions was 73.7 dB(A), and lower values are observed than in the region under study.

Average peak values

In parallel, the means of the measurements were carried out at each point studied, a survey of the maximum levels of measured noises and the means of these peaks (higher values recorded at each point) were recorded. The peaks of noise levels are the maximum values captured by the sound meter when measuring in the field. The equipment records the noise averages and reports this average as leq, in addition to informing the value of each noise level captured, including the maximum level in the respective measurement (Peak).

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noise level captured, including the maximum level in the respective measurement (Peak).

As a rule, the highest noise peaks (Figure 7) were recorded due to noises emitted by motorcycles (several circulating at the same time at the exit of traffic lights or those with high displacement and/or "open leakage"), accelerations, decelerations and braking of heavy vehicles (trucks, buses and trailers), horns, holes and unevenness in the road and, vehicles that drive at high speed with faulty exhaust system or high-power motor vehicles.

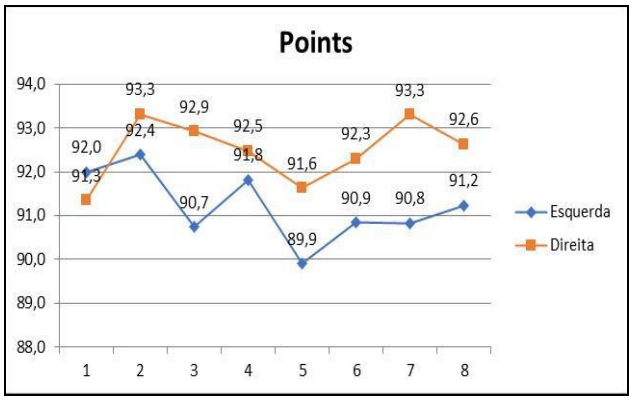

Fig.7: Average measurements of peaks per point.

Source: The Authors (2022).

Analyzing the means of the noise peaks (Figure 8), at each point, it is noted that the noises on the right side of the road are predominantly higher, except in point 1D, which is the point where the vehicles exit after the signal opens and that bus traffic already slowing down to stop near the 2D point predominates. It is observed that in point 1D there were variations of peaks between 82.7dB(A) and 101.2 dB(A). In point 1E, the average peak noise is due to the result of, on the left side of the road, there is a predominance of motorcycle exit after the opening of the traffic light, maintaining almost continuously the preference of this side of the road. On the other hand, the peaks at this point ranged from 83.3 dB(A) to 101.4 dB(A), with several episodes of peaks above 101 dB(A).

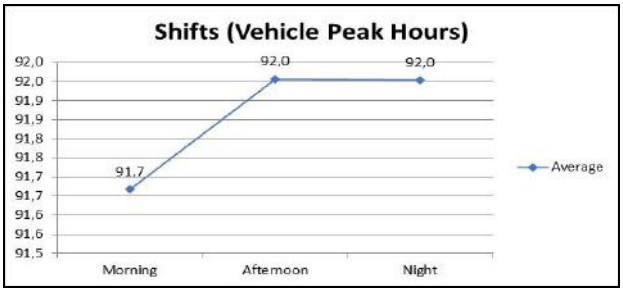

Fig.8: Average peak noise per turn.

Source: The Authors (2022).

In view of such high noise values, as observed in Figures 7 and 8, it is suggested that the population living in the region, in the vicinity of the avenues studied should suffer some health impact. In their studies, Dias et al. (2019) state that the damage caused by excessive noise can manifest in several ways, where the most common are hearing loss, sleep loss, recurrent headache, difficulty in communication and increased absenteeism rate. In 2018, the World Health Organization (OMS, 2018) updated its guidelines for Europe and classified health outcomes related to exposure to urban noise as critical and important. Among the critical outcomes, the: cardiovascular diseases, discomfort, sleep disorders, cognitive impairment, hearing loss and tinnitus were mentioned.

Because it is an average of the maximum noise levels recorded, it is observed that the afternoon and night periods are above the mean values of the morning (Figure 9). It is understood to be this episode justified due to the shifts where there is a greater flow of vehicles and because of a greater will/need of drivers wanting to reach the destination, after the workday or when they return for lunch time. According to Coelho (2019) there are no lack of normative instruments of accountability in the civil, administrative or l spheres, however, the population in general violates the right to silence, perhaps because they do not know the health impacts. Dias et al (2021) state that the landscape of urban environments encompasses several sources of noise, and others promote the disturbance of silence and can be observed in people's daily lives during leisure time and sports practices.

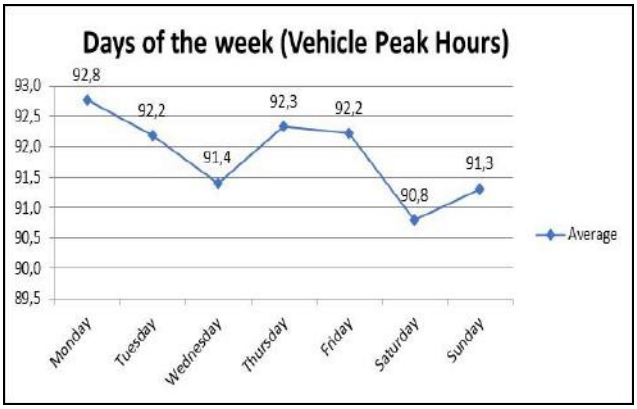

Fig.9: Average noise peaks per day of the week.

Source: The Authors (2022).

Although the records show that on Sundays there were the highest episodes of peaks above 100 dB(A), the highest recorded average of noise peaks occurs on Mondays, due to a marked average in the range of 90 dB(A) to 99 dB(A).

IV. CONCLUSION

The fact that all the sampled points presented sound noises above the limits recommended by the current norms, regarding acoustic comfort, demonstrates the need to promote educational measures, as well as an effective supervision by the competent bodies. Therefore, it is recommended a broad acoustic mapping together with the government, so that this information is in line with the C age Master Plan and serves as subsidies for intervention strategies and formulation of laws that will reduce noise pollution on the roads.

Municipal managers are suggesting a wide supervision of noise from vehicle traffic, especially motorcycles and collectives, since they are the largest sources of high noise emissions. It is also recommended the implementation of measures aimed at reducing the permitted speed of the roads with greater circulation of vehicles identified in the study as Critical Zones. However, this study functions as an instrument for decision-making and a starting point for the elaboration of noise inspection actions.

Obtaining data that could prove the impacts on human health by the noise caused by the avenues under study would require a more careful evaluation, based on the implementation and monitoring of noise inside adjacent houses, which would require a joint institutional effort to this realization.

ACKNOWLEDGEMENTS

To Technological Institute of Pernambuco.

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